## TABLE OF CONTENTS

	List of Figures
	List of Tables ix
	Preface
	Abbreviations xiii
Part 1	Model Overview
1	General Description
1.1	Introduction
1.2	Historical Background
1.3	Model Characteristics
Part 2	Functional Specifications
2	Physical and Hydrologic Components
2.1	Rainfall
2.2	Evapotranspiration
2.3	Overland Flow
2.4	Subsurface Flow
2.5	Canal Routing
2.6	Initial and Boundary Conditions
3	Policy and System Management Components
3.1	Lake Okeechobee
3.2	Supply-Side Management for the Lake Okeechobee Service Area
3.3	Everglades Agricultural Area86
3.4	Everglades Protection Area
3.5	Simulation of the Lower East Coast of South Florida
Part 3	Miscellaneous Topics
4	Calibration
4.1	Calibration of the EAA
4.2	Calibration of the Everglades and the LEC
5	Sensitivity Analysis
5.1	Methodology
5.2	Results of Sensitivity Analysis
6	Uncertainty Analysis
6.1	Methodology
6.2	Results of Uncertainty Analysis
	References

	Glossary
	Appendices
A.	Data Input and Output
B.	Overall Model Structure
C.	Function / Subroutine Description
D.	Post-Processing / Analysis Tools and Utilities
E.	Calibration / Verification Plots for the Everglades Agricultural Area
F.	Water Level Calibration / Verification Plots for the Everglades and the Lower
	East Coast Service Areas
G.	Canal Stage Calibration / Verification Plots for the Lower East Coast Service Areas
H.	Structure Discharge Calibration / Verification Plots for the Lower East Coast
	Service Areas

- I. Definition of (Major) Discharge Variable Names in the SFWMM
- J. Water Budgets for Model calibration Run (Annual, Dry Season and Wet Season Summaries)
- K. Water Budgets for Model Verification Run (Annual, Dry Season and Wet Season Summaries)

## LIST OF FIGURES

1.2.1	Evolution of the South Florida Water Management Model	3
1.3.1	South Florida Water Management Model Boundaries	
1.3.2	General Hydrologic Processes in the South Florida Water Management Model	7
1.3.3	Simplified Flowchart for the South Florida Water Management Model	8
1.3.4	The South Florida Water Management Modeling System	
1.3.5	Major Geographical Areas within the South Florida Water Management Model	
	where Standard Water Budget Summaries are Written During Post-Processing of	
	Model Output	. 11
2.1.1	Location of Rainfall Stations Used to Create Rainfall Input Data for the	
	Computational Grid Cells in the South Florida Water Management Model	. 13
2.2.1	Conceptual Representation of the Different Lake Okeechobee Evapotranspiration	
	Zones as Implemented in the South Florida Water Management Model	. 17
2.2.2	Meteorological Stations Used to Calculate Reference ET (Based on the Penman-	
	Monteith Equation) on a Daily Basis as Input to the South Florida Water	
	Management Model	. 19
2.2.3	KFACT as a Function of Water Table Location	. 21
2.2.4	Land Cover / Use Classification Scheme Used in the South Florida Water	
	Management Model (v3.5)	. 22
2.3.1	Location of Grid (Source and Destination) Cells Used in Calculating Total Head at	
	Grid Cell (i,j) During Time Step t+1 as Implemented in the Overland Flow	
	Subroutine in the South Florida Water Management Model	. 33
2.3.2	Land Surface Elevation Map for the South Florida Water Management Model	
	(v3.5)	. 35
2.4.1	Canal-Levee Configuration Representing a Typical Transect Used in Developing	
	Empirical Levee Seepage Equations in the South Florida Water Management	
	Model	. 39
2.4.2	Sections or Transects Across the Major Levees Used to Formulate Levee Seepage	
	Equations in the South Florida Water Management Model	. 40
2.4.3	Surficial Aquifer Transmissivity Map for the South Florida Water Management	
	Model (v3.5)	. 43
2.4.4	Location of Grid Cells Used in Calculating Total Head at Grid Cell (i,j) During	
	Time Step t+1 as Implemented in the Groundwater Flow Subroutine in the South	
	Florida Water Management Model	
2.4.5	Generalized Block Diagram of Surface-Subsurface Interaction in the SFWMM	. 50
2.6.1	USGS Tidal Stations Used to Define Coastal Boundary Conditions in the South	
	Florida Water Management Model	
3.1.1	Lake Okeechobee Stage-Area-Storage Relationships	
3.1.2	Lake Okeechobee Regulation Schedule	
3.1.3	Overall Operating Levels for Lake Okeechobee	
3.1.4	Schematic Diagram of Caloosahatchee Basin/Estuary Simulation Module	. 73
3.1.5	Flowchart for Lake Okeechobee-St. Lucie Basin/Estuary Linkage as Implemented	
	in the South Florida Water Management Model	. 74

3.2.1	Flowchart for Supply-Side Management as Implemented in the South Florida	
	Water Management Model	83
3.3.1	South Florida Water Management Model Grid Superimposed on Major Basins in	
	the Everglades Agricultural Area	87
3.3.2	Conceptual Diagram of the Hydrologic System in the Everglades Agricultural Area	
	as Represented in the South Florida Water Management Model	88
3.3.3	Conceptual Representation of an EAA Grid Cell in the SFWMM	89
3.3.4	Variation of Theoretical Total Evapotranspiration, $ET_0$ , as a Function of Depth	92
3.3.5	Canal-Structure Configurations Used in Calculating Canal Conveyance Capacities	
	for the Everglades Agricultural Area Algorithm in the South Florida Water	
	Management Model	102
3.3.6	Location of the Proposed Stormwater Treatment Areas	103
3.3.7(a)	Flow Distribution Within and Around the Everglades Agricultural Area without	
	the Proposed Stormwater Treatment Areas (current base condition) in the South	
	Florida Water Management Model	105
3.3.7(b)	Flow Distribution Within and Around the Everglades Agricultural Area with the	
	Proposed Stormwater Treatment Areas In Place (future base condition) as	
	Implemented in the South Florida Water Management Model	106
3.3.8	Trigger Lines for Proposed Lake Okeechobee Aquifer Storage and Recovery, and	
	North Storage as Used in the South Florida Water Management Model	111
3.4.1	Surface Water Management Basins in the Everglades: Water Conservation Areas	
	and Everglades National Park	113
3.4.2	WCA-1 Basin Boundary, Canals and Water Control Structures	114
3.4.3	WCA-2A Basin Boundary, Canals and Water Control Structures	116
3.4.4	WCA-2B Basin Boundary, Canals and Water Control Structures	117
3.4.5	WCA-3A Basin Boundary, Canals and Water Control Structures	119
3.4.6	WCA-3B Basin Boundary, Canals and Water Control Structures	120
3.4.7	Everglades National Park Basin Boundary, Canals and Water Control Structures	121
3.4.8	SFWMM Grid Cell Network with Model Boundary and Water Budget Basins	
	Superimposed on a Map of South Florida with Major Canals	
3.4.9	Regulation Schedule for Water Conservation Area 1	
3.4.10	Regulation Schedule for Water Conservation Area 2A	
3.4.11	Regulation Schedule for Water Conservation Area 3A	
3.4.12	Regulation Schedules for Water Conservation Areas 1, 2A, and 3A	129
3.4.13	Conceptual Diagram of Proposed Operations Associated with Everglades	
	Environmental Deliveries and Flood Control Releases	134
3.4.14	Flow Routing Associated with the Proposed Everglades Rain-Driven Operations	
	as Implemented in the South Florida Water Management Model	136
3.5.1	Primary Structures Used in Making Water Supply Deliveries to the Three Service	
	Areas within the Lower East Coast	142
3.5.2	Hypothetical Canal Network Used to Explain Water Supply Needs Calculations in	
	the South Florida Water Management Model	144
3.5.3	Sequence of Water Supply Needs Calculations for the Hypothetical Canal	
	Network	148
3.5.4	Flowchart for Calculating Water Supply Needs for the Lower East Coast as	

	Implemented in the South Florida Water Management Model
3.5.5	Systems Diagram of Processes Simulated in the South Florida Water Management
	Model for Irrigated Cells within the Lower East Coast Service Area
3.5.6	Location of Key Trigger Cells in the South Florida Water Management Model
	Used to Trigger Water Restrictions in the Lower East Coast Developed Area 158
3.5.7	Flowchart for Water Shortage Plan as Implemented in the South Florida Water
	Management Model
4.1.1	Everglades Agricultural Area Unsaturated Zone Storage Triggers for Runoff and
	Supplemental Flow as Implemented in the South Florida Water Management
	Model
4.1.2(a)	Comparison of SFWMM Simulated Monthly Runoff and Supplemental Flow for
	the Everglades Agricultural Area with Historical Data (1979-1989) 166
4.1.2(b)	1
	the Everglades Agricultural Area with Historical Data (1990-1995) 167
4.1.3(a)	Comparison of SFWMM Simulated Mean Monthly Runoff and Supplemental Flow
	for the Everglades Agricultural Area with Historical Data (1979-1989) 167
4.1.3(b)	Comparison of SFWMM Simulated Mean Monthly Runoff and Supplemental Flow
	for the Everglades Agricultural Area with Historical Data (1990-1995) 168
4.1.4(a)	1
	Everglades Agricultural Area with Historical Data (1979-1989)
4.1.4(b)	Comparison of SFWMM Simulated Annual Runoff and Supplemental Flow for the
4 1 5 ( )	Everglades Agricultural Area with Historical Data (1990-1995)
4.1.5(a)	X-Y Plot of SFWMM Simulated Monthly Everglades Agricultural Area Runoff
1 1 E(L)	and Historical Data (1979-1989)
4.1.5(b)	X-Y Plot of SFWMM Simulated Monthly Everglades Agricultural Area Runoff
116(0)	and Historical Data (1990-1995)
4.1.6(a)	X-Y Plot of SFWMM Simulated Monthly Everglades Agricultural Area Supplemental Flow and Historical Data (1979-1989)
116(b)	X-Y Plot of SFWMM Simulated Monthly Everglades Agricultural Area
4.1.0(0)	Supplemental Flow and Historical Data (1990-1995)
4.2.1	Location of Selected Groundwater Level Monitoring or Observation Wells Used in
7.2.1	the South Florida Water Management Model Calibration
4.2.2	Location of Major Control Structures Simulated in the South Florida Water
	Management Model
4.2.3(a)	Comparison of Simulated and Historical End-of-Month Stages at Gage Location
	G1074B for Period of Record 1979-1990
4.2.3(b)	Comparison of Simulated and Historical End-of-Month Stages at Gage Location
( )	G853 for Period of Record 1979-1990
4.2.4(a)	Comparison of Simulated and Historical End-of-Month Stages at Gage Location
	G1315 for Period of Record 1979-1990
4.2.4(b)	Comparison of Simulated and Historical End-of-Month Stages at Gage Location
	G1316 for Period of Record 1979-1990
4.2.5(a)	Comparison of Simulated and Historical End-of-Month Stages at Gage Location
	PB831 for Period of Record 1979-1990
4.2.5(b)	Comparison of Simulated and Historical End-of-Month Stages at Gage Location

	BR105 for Period of Record 1979-1990	80
4.2.6(a)	Comparison of Simulated and Historical End-of-Month Stages at Gage Location	
` /	3A-2 for Period of Record 1979-1990	82
4.2.6(b)	Comparison of Simulated and Historical End-of-Month Stages at Gage Location	
` '	3A-4 for Period of Record 1979-1990	82
4.2.7(a)	Comparison of Simulated and Historical Mean Monthly Stages along upper	
` /	C-103N Canal (S-166HW) for Period of Record 1979-1990	83
4.2.7(b)		
` '	(G-54HW) for Period of Record 1979-1990	83
4.2.8	Comparison of Simulated and Historical Mean Monthly Stages along C-111 Canal	
	(S-177HW) for Period of Record 1979-1990	84
4.2.9	Comparison of Simulated and Historical Mean Monthly Stages along C-51 Canal	
	(S-155HW) for Period of Record 1979-1990	84
4.2.10	Comparison of Simulated and Historical Flows at Structure S-177 for Period of	
	Record 1979-1990	85
4.2.11	Comparison of Simulated and Historical Flows at Structure S-155 for Period of	
	Record 1979-1990	86
5.2.1	Components of the Sensitivity Matrix for Lower East Coast Service Area 1	90
5.2.2	Components of the Sensitivity Matrix for Lower East Coast Service Area 2	91
5.2.3	Components of the Sensitivity Matrix for Lower East Coast Service Area 3	92
5.2.4	Components of the Sensitivity Matrix for Water Conservation Areas	93
5.2.5	Components of the Sensitivity Matrix for Everglades National Park	94
5.2.6	Components of the Sensitivity Matrix for Canals	96
5.2.7	Components of the Sensitivity Matrix for Coastal Flows	97
6.2.1	Simulated Versus Historical Water Levels for Gage 1-7	16
6.2.2	Simulated Versus Historical Water Levels for Gage 3A-28	16
6.2.3	Simulated Versus Historical Water Levels for Gage 3A-4	17
6.2.4	Simulated Versus Historical Water Levels for Gage 3A-10	17
6.2.5	Simulated Versus Historical Water Levels for Gage 2A-159	18
6.2.6	Lower East Coast Service Area 1 (1979-1990) - Flows to Tide	18
6.2.7	Lower East Coast Service Area 2 (1979-1990) - Flows to Tide	19
6.2.8	Lower East Coast Service Area 3 (1979-1990) - Flows to Tide	19

## LIST OF TABLES

2.2.1	Variation of KFACT as a Function of Water Table Location
2.2.2	Static ET Parameters Used in the South Florida Water Management Model 23
2.2.3	Vegetation/Crop Coefficient (KVEG) as a Function of Land Use and Month as
	Implemented in the South Florida Water Management Model
2.3.1	Overland Flow Resistance Coefficients Used in the SFWMM
2.4.1	Levee Seepage Coefficients ( $\beta_0$ , $\beta_1$ , $\beta_2$ ) Used in the SFWMM
2.5.1	Values of Parameter A Used to Define Manning's n for Cell-to-Canal or Canal-to-
	Cell Overland Flow in the South Florida Water Management Model
3.1.1	Lake Okeechobee Operations in the South Florida Water Management Model 63
3.1.2	EAA Pump Capacities
3.1.3	EAA Gravity Structure Capacities
3.1.4	Lake Okeechobee Hurricane Gate Capacities
3.1.5	Pulse Release Hydrographs for the Three Levels of Zone D Regulation Schedule
	for Lake Okeechobee
3.2.1	Some Characteristics of Lake Okeechobee Service Areas
3.2.2	Normal Dry Season Lake ET and Rainfall, and EAA Water Use Incorporated in
	the Supply-Side Management Module of the South Florida Water Management
	Model
3.2.3	Normal Cumulative Dry Season Lake ET and Rainfall, and EAA Water Use
	Incorporated in the Supply-Side Management Module of the South Florida Water
	Management Model
3.3.1	Monthly Theoretical Crop Coefficient KVEG for the Three Predominant EAA
	Crop Types
3.3.2	Variation of KFACT in the Equation for Theoretical Total Evapotranspiration as a
	Function of Depth
3.3.3	Operational Constraints Used in the SFWMM for Removing Excess Runoff from
	EAA Basins
3.3.4	Allowable Percentage of Design Discharge Through the Major EAA Conveyance
	Canals
3.3.5	Some Physical Properties of the Eight EAA Canal Reaches Used in Calculating
	Conveyance Capacities Through the EAA
3.3.6	General Operating Considerations for STA-type Reservoirs in the EAA Simulation
	within the South Florida Water Management Model
3.3.7	General Operating Considerations for non-STA-type Reservoirs in the EAA
	Simulation within the South Florida Water Management Model 109
3.4.1	Comparison Between Actual and Modeled Areas in the Everglades Protection
	Area
3.4.2	Trigger Locations for Regulatory Releases from WCAs as Used in the SFWMM 125
3.4.3	Structure Operations Associated with Regulatory Discharges in the Water
	Conservation Areas
3.4.4	Floor Elevations for WCAs Used in the SFWMM
3.4.5	Structure Operations for Water Supply Releases from WCAs to LECSAs 133

3.4.6	Description of Proposed Environmental Water Supply Deliveries Within the	
	Everglades	. 137
3.5.1	List of Inlet Structures for Each Service Area in the Lower East Coast	. 143
3.5.2	Canal Definition Data for Example Hypothetical Canal Network	. 145
3.5.3	Routing Information for Example Hypothetical Canal Network	. 145
3.5.4	Branch Information for Example Hypothetical Canal Network	. 146
3.5.5	Binary Input and Output Files Used in the South Florida Water Management	
	Model for the Lower East Coast Unsaturated Zone Accounting	. 155
3.5.6	Proposed Cutbacks For Simulating the Short-Term Water Use Restrictions in the	
	Lower East Coast Service Areas	. 156
4.1.1	General Rules Used in Adjusting Calibration Parameters for the Everglades	
	Agricultural Area in the South Florida Water Management Model	. 164
4.1.2	Final Values of Calibration Parameters Used for the EAA in the SFWMM (v3.5)	. 165
5.1.1	Acceptable Range of Variation for Parameters/Physical Process Expressed in	
	Terms of Calibrated Values	. 188
5.2.1	Parameter Correlation Matrix	. 195
6.2.1	Half-Width of 90% Uncertainty Band and Contributions by Parameters for Lower	
	East Coast Service Area 1	201
6.2.2	Half-Width of 90% Parameter Uncertainty Band and Contributions by Parameters	
	for Lower East Coast Service Area 2	202
6.2.3	Half-Width of 90% Parameter Uncertainty Band and Contributions by Parameters	
	for Lower East Coast Service Area 3	203
6.2.4	Half-Width of 90% Parameter Uncertainty Band and Contributions by Parameters	
	for Water Conservation Areas	205
6.2.5	Half-Width of 90% Parameter Uncertainty Band and Contributions by Parameters	
	for Everglades National Park	206
6.2.6	Half-Width of 90% Parameter Uncertainty Band and Contributions by Parameters	
	for Canals	. 207
6.2.7	Half-Width of the 90% Total Uncertainty Band for Lower East Coast Service Area	
	1	. 209
6.2.8	Half-Width of the 90% Total Uncertainty Band for Lower East Coast Service Area	
	2	. 210
6.2.9	Half-Width of the 90% Total Uncertainty Band for Lower East Coast Service Area	
	3	
6.2.10	Half-Width of the 90% Total Uncertainty Band for Water Conservation Areas	
6.2.11	Half-Width of the 90% Total Uncertainty Band for Everglades National Park	
6.2.12	Half-Width Of the 90% Total Uncertainty Band for Canal Water Levels	. 215